

What is claimed is:

1. A pump assembly useable for pumping two-phase fluids from a subterranean well, the pump assembly having a longitudinal axis and comprising:

a housing; and

5 a first stage, the first stage comprising:

an impeller assembly; and

a diffuser assembly, wherein the impeller assembly and diffuser assembly are collectively configured to produce a diagonal flow path through the first stage.

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2. The pump assembly of claim 1, the diffuser further comprising:

a diffuser hub having a diffuser hub profile; and

a diffuser shroud having a diffuser shroud profile, wherein the diffuser hub and diffuser shroud cause fluid passing through the diffuser to converge

15 towards the inner diameter of the stage.

3. The pump assembly of claim 2, wherein the diffuser hub profile is

formed by the revolution of a first line segment that is inclined to the longitudinal axis of the pump assembly.

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4. The pump assembly of claim 2, wherein the diffuser shroud profile is

formed by the revolution of a second line segment not parallel or co-linear to the first line segment that is inclined to the longitudinal axis of the pump assembly.

5. The pump assembly of claim 1, the impeller further comprising:
an impeller hub having an impeller hub profile; and
an impeller shroud line having an impeller shroud line profile, wherein the
5 impeller hub and impeller shroud line cause fluid passing through the
impeller to diverge towards the outer diameter of the stage.

6. The pump assembly of claim 5, wherein the impeller hub profile is
formed by the revolution of a third line segment that is inclined to the longitudinal axis
10 of the pump assembly.

7. The pump assembly of claim 5, wherein the impeller hub profile is
formed by the revolution of a fourth line segment that is inclined to the longitudinal axis
of the pump assembly.

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8. The pump assembly of claim 1, wherein the impeller further comprises a
balance hole.

9. The pump assembly of claim 1, wherein the diffuser further comprises a
20 thrust washer.

10. The pump assembly of claim 1, wherein the pump assembly comprises a
plurality of stages.

11. The pump assembly of claim 10, wherein each of the plurality of stages includes an impeller and a diffuser that are cooperatively configured to produce a diagonal flow path.

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12. The pump assembly of claim 11, wherein different diagonal flow path are produced by the plurality of stages.

13. A downhole submersible pumping system, comprising:
10 a motor;
production tubing; and
a first pump assembly coupled to the motor and production tubing, wherein the first pump assembly includes at least one stage that is configured to produce a diagonal flow path.

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14. The downhole submersible pumping system of claim 13, further comprising a second pump assembly coupled between the first pump assembly and the production tubing, wherein the second pump assembly is configured to produce radial flow profiles.

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15. The downhole submersible pumping system of claim 13, wherein the first pumping assembly includes a plurality of turbomachinery stages configured to produce diagonal flow path.

16. The downhole submersible pumping system of claim 15, wherein the first pumping assembly further includes at least one turbomachinery stage configured to produce a non-diagonal flow path.

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17. A pump assembly for handling two-phase flow, the pump assembly comprising:

a housing;

a shaft; and

10 means for producing diagonal flow paths as fluid moves through the pump assembly.